trievably diseased postmortem that any radical cure would have been out of the question. A tabular statement of the operations is herewith appended.[1]

Summary of Operations on Forty Patients (Several Patients had more than one Operation).

Operation.	Total.	Recovery.	Death.	Mortality. Per cent.
Colostomy	2	1	1	50.0
Enterolysis for obstruction by adhesions, etc.	8	8	0	00.0
Enterorrhaphy for fecal fistula	7	7	0	00.0
" for typhoid perforation	1	1	0	00.0
Enterotomy for obstruction	1	1	0	00.0
Ileocolostomy	6	5	1	16.6
Ileosigmoidostomy	6	3	3	50.0
Intussusception reduced	1	1	0	00.0
Laparotomy for dynamic intestinal obstruction	1	1	0	00.0
Laparotomy to release kink causing obstruction	1	1	0	00.0
Resection of small intestine, with end-to-end anastomosis	5	3	2	40.0
Resection of cecum, including portions of ileum and ascending colon	3	2	1	33.3
Resection of hepatic flexure of colon, including portion of ascending and transverse colon, with end-to-end anastomosis of colon in one case, and a lateral anastomosis of ileum to transverse colon in the other	2	2	0	00.0
Resection of sigmoid flexure and ileosigmoidostomy	1	1	0	00.0
Sigmoidoproctostomy	1	0	1	100.0
Total operations	46	37	9	17.3
Total patients	40	31	9	22.5

ACCIDENTS FOLLOWING THORACENTESIS: PNEUMOTHORAX; SUDDEN DEATH FROM EXPLORATORY PUNCTURE.[2]

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Wilson Fox, writing as late as 1891, said that "a comparison of available published cases of pleurisy treated by paracentesis with tables of the general mortality of pleurisy shows that the mortality of the operation, as practised in serous effusions, exceeds and in some instances by an enormous proportion, the worst mortality of all hospital cases," but with earlier resort to paracentesis and improved technique, due chiefly to the recognition of the necessity of strict surgical cleanliness, the results of the operation are now so uniformly satisfactory that the possibility of accident is hardly considered, and it has become a routine practice both as a diagnostic and a therapeutic measure. Accidents, however, do occur, even though nothing more than an exploratory puncture is done, which vary in severity from the pleuritic urticaria, described by Minciotti to a more or less speedy death. The greatest interest attaches to those in which albuminous expectoration, sudden death from exploratory puncture, and pneumothorax have occurred. The first has recently been discussed at length by Riesman, who gives a full bibliography of the subject. The other two alone are considered in this paper.

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[1] A short abstract of the cases herewith referred to will be found in the Trans. Amer. Surg. Assoc., 1906.

[2] Read at the meeting of the Association of American Physicians, Washington, D. C., May 15 and 16, 1906.

Sudden death after the removal of even moderate amounts of fluid is a well-recognized event, but it is not so well known that it may also follow simple exploratory puncture. Attention has been especially drawn to this possibility by Carpenter, Russell, Parkinson, Fortescue-Brickdale, Oliver, and Wilks, who report in all nine cases. A tenth recently occurred under anesthesia at St. Thomas' Hospital and was the subject of a medicolegal inquiry. Seven of these were children, and in at least eight instances a solidified lung was the cause of the ambiguous signs and had been punctured by the needle. Russell concludes from a careful study of the three cases reported by him, none of which showed any gross lesion of the brain, and from animal experimentation, that it would seem that the sudden syncopal symptoms are due to afferent impulses conveyed to the medulla along the vagus nerve, whose terminal fibers, rendered unduly sensitive by compression or inflammation, are irritated by the needle. He considers the pulmonary fibers a more likely source of the impulse than the pleural. Death may be immediate or be preceded for several days by unconsciousness and convulsions, which depend upon the cerebral anemia produced by cardiac inhibition and the extreme lowering of the blood pressure. This has been accepted as an efficient explanation in most of the cases, but syncope and possibly axphyxiation, due to hemorrhage from the wounded lung, appear at times to have taken an active part. In the following case, which occurred at the Boston City Hospital in the service of Dr. J. L. Morse, to whom I am indebted for the privilege of reporting it, it is hardly probable that the exploring needle could have reached the pulmonary branches of the vagus, as autopsy showed that the two surfaces of the pleura were separated by a considerable layer of fluid.

The patient, a man aged forty years, entered the hospital July 10, 1899, with an effusion filling the left chest to the third rib. On the day after entrance sixty-four ounces of bloody fluid was removed by aspiration. The symptoms were considerably relieved, but the temperature remained elevated and the fluid reaccumulated, so that on August 1 a second attempt at aspiration was made. The prospect of operation apparently produced no mental perturbation (which has also been considered a possible factor), and he did not wince when the needle was introduced, but he almost immediately collapsed and became cyanotic and almost pulseless. The needle was at once withdrawn. Efforts at stimulation failed, and he became unconscious and died about fifteen hours later. There were no symptoms which suggested a possible cerebral lesion. A postmortem incision of the chest only was allowed. The left pleural cavity contained several hundred cubic centimeters of bloody fluid, and the left lung was much compressed, containing practically no air with the exception of a little in the upper lobe. The lower part of the upper lobe and the whole of the lower were covered with membrane from 1 to 2 mm. in thickness. Scattered through this fibrous covering and over the parietal pleura, which was also thickened, were numerous small gray tubercles. Careful examination of the lung failed to reveal any old tuberculous focus. The heart was normal. The kidneys showed acute glomerular nephritis.

The earliest record of pneumothorax resulting from thoracentesis, which I have been able to find, was made by Hughes in 1847. The patient was a man, thirty-four years old, who had previously suffered from hemoptysis and who developed an effusion in the right pleura. He was tapped fifteen or sixteen times in a period covering about two years. Annoyed by the trouble and expense of so much medical attendance, he performed the later operations himself. At one of the earlier times "during a sudden inspiration, for which his physicians were unprepared, he drew into the pleura a considerable quantity of air, but did not suffer from the operation more than on former occasions." The account of the method adopted in order to evacuate as much of the fluid as possible is interesting, and I quote Hughes' words: "The patient was accustomed, after the cannula was in place, to rest his body on the bed and his right hand on the floor, and to prevent the ingress of air into the pleura by making a stopcock of the finger of his left hand when the fluid became low and he wanted to inspire. He would strain, and by thus compressing the contents of the thorax the fluid would flow freely, and before the effort was discontinued, he would stop the cannula with his finger, and then breathe several times; after which another effort would be made, till at length he became tired and his breathing became troublesome, when the cannula was withdrawn." I have been able to find, since Hughes' time, in a search of the literature which cannot claim to have been exhaustive, references to about fifty cases. To these I would add a brief report of four which have occurred comparatively recently at the Boston City Hosptial.

Case I.—Thomas R., aged forty-five years, alcoholic, was admitted February 10, 1905. He had complained for three months of cough, feverishness, and chills. On entrance many coarse moist rales throughout both chests were the only abnormal signs found on physical examination, but he soon developed an effusion in the right pleura and was twice aspirated. Seven ounces of thin purulent fluid, containing streptococci, was obtained the first time and thirteen the second, the needle being introduced just outside the angle of the scapula. Shortly after the second aspiration an area of amphoric respiration and voice was found near the angle of the scapula; this gradually extended, and well-marked signs of pneumothorax developed, though succussion and the coin sound were never obtained. A week later the air was entirely absorbed and was replaced by fluid. He refused operation and after his discharge was lost sight of.

CASE II.—James S., aged thirty-two years, was admitted March 20, 1905, with a pneumonic process involving the greater portion of the right lung. The temperature returned to normal by lysis during the following five days, but two days later again rose and signs of effusion were discovered. This increased until aspiration seemed advisable and forty ounces of blood-tinged sterile serum were withdrawn. During the process the needle became accidentally detached from the aspirator and air was heard to enter the chest. In spite of much apparent relief most distinctive evidence of the presence of pneumothorax was later found, as shown by an area of tympany over the upper portion of the chest with dulness below, the tympany and dulness rapidly shifting their position with every change in the posture of the patient. No record was made of the presence of the coin sound or the succussion splash. Fluid gradually replaced the air and a month later the chest was so full that he was again tapped and fluid of the same character obtained. The following day he felt so well that he insisted upon his discharge. There was then no evidence of pneumothorax.

CASE III.—This case is reported with some reserve, as the signs before aspiration were difficult to interpret and there was some reason to doubt if there was not already a small amount of air in the chest. The patient, Patsey C., an Italian about thirty years old, was admitted February 28, 1906, with a history of an illness of two weeks' duration. The signs at the base of the right chest suggested fluid, and on March 5, largely for the sake of diagnosis, a needle was introduced just outside the angle of the scapula, but nothing was obtained. One hour later the chest was much more resonant than before and the respiratory murmur was diminished and the coin sound obtained over an area the size of the hand at the level of the lower half of the scapula in the neighborhood of the puncture. On the following day most conclusive evidence of the existence of air and fluid in the chest was found, all the typical signs of hydropneumothorax being present. He was later aspirated three times, at intervals of about two weeks. When discharged in May the heart had returned to its normal position. The lung had not fully expanded, and a deposit still persisted at the base of the right chest. The presence of air was not shown by any physical signs. His general condition was consistent with a progressive tuberculous infection, though positive evidence was still lacking.

Case IV.—The patient, a boy aged nineteen years, was seen through the courtesy of Dr. C. F. Withington, to whose service he was admitted April 17, 1906. He entered with pneumonia, which finally involved the whole right lung. The temperature returned to normal on April 30 and remained so for four days. It then rose once more and apparently typical signs of a complicating empyema developed. On May 8, a needle was twice introduced into the right back, each time with a negative result. On the following morning the right chest was distended and there was a tympanitic area over the front extending beyond the left edge of the sternum and outward into the axilla, where it gave place to flatness. The upper limit of flatness changed rapidly with each change in the position of the patient. The respiratory murmur and voice sounds were much diminished over the tympanitic area, but neither the coin sound nor the succussion splash was present. The left border of the heart was outside the nipple line. The patient died that afternoon, but as his condition was critical before the exploratory punctures were made, it is doubtful if they influenced the ultimate result, though death was probably hastened.

The small number of such accidents, which have been recorded, cannot represent anything like the frequency with which they occur in practice. The natural disinclination to record unsuccessful cases may partially account for it, but as the mass of literature is made up mostly of single observations, which seem to have been reported because they were unusual experiences, I am inclined to lay greater stress on failure of recognition. Ewart says that it is frequently overlooked because not looked for, and states that he has witnessed it repeatedly of late, and, though they presented no difficulties in diagnosis, the more careful examination given to patients after paracentesis, since my attention was drawn to this particular accident, may partly account for my experience in meeting three cases within a comparatively short time.

Its presence cannot fail to be discovered when increased dyspnœa, cyanosis, and all the classical signs of pneumothorax immediately follow, but it may readily be missed in the perfunctory examination often given a class of patients which excites but little interest, when it presents no symptoms at its onset and exerts no apparent influence on the course of the original disease, or when the signs are ambiguous, are late in appearing, or can only be elicited in certain positions of the patient, especially when he is too ill to be freely moved. The difficulties of diagnosis in a number of the reported cases were not inconsiderable, and it was discovered only because the patients were given a thorough examination. At times only a probable diagnosis can be made, but in doubtful cases efficient aid may be furnished by the *x*-rays.

A great majority of the patients recover, much larger probably than the recorded cases show, if, as I believe, it is frequently overlooked. The break in the lung tissue is usually soon healed and the air is more or less rapidly absorbed. A serous effusion has in rare instances been converted into an empyema, and sudden death from suffocation, due to the rapid inrush of air, has occasionally occurred, a result which might sometimes be avoided by immediate resort to free incision of the chest wall. About a third of the reported patients have died from one cause or another, but in most of them it was extremely doubtful if the pneumothorax had contributed materially to the fatal termination.

The causes assigned for the accident have been multiple. The occurrence of pneumothorax from gaseous exhalations from the pleural fluid, which was ardently debated forty years ago, and its production *ex vacuo*, which was advocated by Weil, have historical rather than practical interest. Five cases have been reported in which the aspirating pump was accidentally reversed and the condensed air in the bottle was blown into the chest. All of these recovered, but a sixth case has recently been communicated to me by a colleague, where the child immediately died. They can scarcely represent the frequency of the accident, which is not one about which the utmost frankness can be expected. Some cases have been explained as due to suction of air, through an unguarded needle, exerted by the negative pressure within the pleural cavity, and in one of the four reported it was distinctly heard to enter in this way; but in the short time, during which this was possible, no such amount as the signs showed to be present could have accumulated. There seems reason for grave doubt if this is ever the mechanism by which an appreciable pneumothorax is produced. At all events, the occasions must be rare. In the majority of cases in which fluid was obtained, it was impossible to determine whether it was due to puncture of the lung, to a tear of the pleura bound down by adhesions, or to the rupture of cavities or emphysematous bullæ caused by the expansion of the lung. Exploratory puncture in the absence of fluid may give rise to pneumothorax or may cause an analogous accident, a subcutaneous emphysema without pneumothorax, which, I am told by my colleagues, who see more of children, is not very rare in young subjects. While a small amount of emphysema around the site of puncture has been observed a number of times, my own experience is confined to but one well-marked case, which was seen with Dr. R. C. Larrabee. The patient was a boy, four years old, who was brought to the out-patient department with signs at the base of the right chest, which led to doubt in diagnosis between solidified lung and fluid. A small aspirating needle was introduced near the angle of the scapula, but only a small amount of blood was obtained. On removing the needle, the child, who up to this time had been unusually quiet, coughed several times; immediately a patch of emphysema appeared in the chest wall, which rapidly extended until it covered the right back from shoulder to hip. He recovered within a few days.

Accidents resulting from the reversal of the aspirating pump or the possible sucking in of air through an unguarded needle are easily prevented by greater care in technique. There seems no way of avoiding those due to puncture of a solid lung by a needle introduced solely for diagnostic purposes, but they are a warning against its too reckless use before the resources of physical examination have been exhausted. Certain precautions, however, may be taken to diminish the number of those which accompany the removal of fluid, for it is noteworthy that they occurred more frequently in the chronic cases and in those in which the effusion was purulent, than in the acute serous cases, and that in a very considerable proportion large quantities were withdrawn. The rapidity of evacuation may also be an important factor, especially when only a few hundred cubic centimeters are removed, the lung from loss of elasticity being unable to expand quickly enough to occupy the vacant space. These dangers may be partially averted by allowing the fluid to run slowly and by stopping its flow after a moderate amount has been obtained, special care being taken in chronic cases and in empyemas. Experience has shown that the removal of the last drop is an unnecessarily thorough procedure, for the evacuation of even a small quantity, by altering the intrapleural pressure, not infrequently leads to rapid absorption. Siphonage is decidedly safer when the effusion is large or has existed for a long period; safer still appears the method proposed by Forlanini, by which sterile air is introduced to replace the fluid removed.

BIBLIOGRAPHY.

Anders and McFarland. Proc. Path. Soc. Phila., 1897–1898, n. s., i, 36.
Biach. Wien. med. Woch., 1880, xxx, 6, 37, 60, 142, 168, 406, 431.
Biggs. N. Y. Med. Jour., 1888, xlviii, 177.
Bucquoy. Gaz. hebd. de med. et chir., Paris, 1879, 2. s., xvi, 789.
Carpenter. AMER. JOUR. MED. SCI., Phila., 1893, n. s., cvi, 422.
Catrin. Bull. et mém. Soc. méd. d. hôp. de Paris, 1894, 3. s., xi, 177.
Emerson. Johns Hopkins Hosp. Rep., Baltimore, 1903, xi, 1–450.
Ewald. Charité Ann., Berlin, 1874, i, 153.
Ewart. Progressive Medicine, Philadelphia, 1905, iii, 50.
Flint. American Clinical Lectures, New York, 1875, i, 63.
Fortesque-Brickdale. Report. Soc. for Study of Dis. in Child., London, 1904–05, v.
Fox. Diseases of the Lungs and Pleura, London, 1891.
Galliard and Bruneau. Bull. et mém. Soc. méd. d. hôp. de Paris, 1897, 3. s., xiv, 567.
Galliard. Bull. et mém. Soc. méd. d. hôp. de Paris, 1905, 3. s., xxii, 762.
Huber. Arch. Pediat., New York, 1892, ix, 600.
Hughes. Lond. Med. Gaz., 1847, n. s., iv, 226.
Lebert. Berl. klin. Woch., 1873, x, 608.
von Mayer. Rev. méd. de la Suisse Rom., Genève, 1901, xxi, 112.
Meunier. Arch. gén. de méd., Paris, 1895, 8. s., iii, 551.

Northrup. Arch. Pediat., N. Y., 1905, xxii, 192.
Oeri. Die Thoracentese, Stuttgart, 1876. Case 15
Oliver. Lancet, London, 1894, i, 26.
Parkinson. British Jour. of Child. Dis., London, 1905, ii, 337.
Peyrot. La Pleurotomie, Thèse de Paris, 1876.
Phalip. Du Pneumothorax accidentel (etc.), Thèse de Paris, 1900.
Riesman. Amer. Jour. Med. Sci., 1902, cxxiii.
Russell. St. Thomas' Hosp. Rep., London, 1899, xxviii, 465.
Secretan. Rev. méd. de la Suisse Rom., Genève, 1888, viii, 438.
Signeux. Les rayons de Roentgen et le déplacement du cœur à droite dans les grands épanchements de la plèvre gauche, Thèse de Paris, 1898.
Smith (Eustace). Clinical Studies of Disease in Children, London, 1887.
Tapret and Boulay. Arch. gén. de méd., Paris, 1888, 7. s., xxii, 91.
Variot. Bull. et mém. Soc. méd. d. hôp. de Paris, 1893, 3. s., x, 323.
Variot and Roy. Bull. et mém. Soc. méd. d. hôp. de Paris, 1901, 3. s., xviii, 1040.
Weil. Deut. Arch. f. klin. med., Leipzig, 1881, xxix, 364.
West. Lancet, London, 1895, i, 674.
Wilks. Brit. Jour. of Child. Dis., London, 1905, ii, 462.

THE DIFFERENTIAL DIAGNOSIS OF THE DISEASES HITHERTO GROUPED TOGETHER AS RHEUMATOID ARTHRITIS, CHRONIC RHEUMATISM, ARTHRITIS DEFORMANS, ETC.[1]

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In my two previous papers[2] I endeavored to show that the various joint diseases hitherto known as rheumatoid arthritis, etc., could be classified upon a definite pathological basis. It remained to be proved whether this classification could be carried out clinically; that is, whether it would be useful in practice.

In the present paper I hope to show that these diseases have definite clinical symptoms, as well as definite pathological lesions; and that when these definite symptoms are understood the various diseases can be readily differentiated from one another clinically.

Leaving, for the moment, other considerations aside, it will be found that, clinically, all the diseases associated as rheumatoid arthritis, etc., can be divided into two great classes: (1) Those which begin acutely, with a more or less definite onset, a rise in temperature, general constitutional reaction, local signs of inflammation, followed by remission or intermission, with perhaps permanent but not progressive joint disability; and (2) those which come on insidiously, with no rise in temperature, a slowly progressive course with no intermissions, leading gradually and progressively to more or less complete joint disability. I shall speak of the first of these as the inflammatory or infectious forms, the second as the trophic forms.

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[1] Read at a meeting of the Orthopedic Section of the New York Academy of Medicine.

[2] Amer. Jour. Med. Sci., January and April, 1906.